UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

Maps of the Coweeta Experimental Forest
Outlining Research in Water Resource Conservation and Land Use
Assembled for the Directors of the Agricultural Experiment Stations

APPALACHIAN FOREST EXPERIMENT STATION
ASHEVILLE, NORTH CAROLINA

June 17, 1942

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WATER RESOURCE CONSERVATION THROUGH BETTER LAND USE MANAGEMENT AND REGIONAL PLANNING

Of all the natural resources that are an essential part of our national economy, water is one of the least clearly understood. Public recognition of the importance of water resource conservation has come slowly, following decades of floods and droughts, inadequate water supplies, impaired sanitation facilities, silting and economic loss of reservoirs. Today, competition for municipal and industrial watersheds is greater than ever before, not only in the dry western states but also in the higher rainfall belt of the East.

Water resources are definitely related to climate. Unfortunately, because climate is generally considered as being beyond man's scope of influence, the conservation of water resources has sometimes been associated with climate in this sense. This is not necessarily true. Climate does determine the amount of rainfall in any locality, and temperature, wind movement, and other climatic factors do influence the amount of available water. But within any one locality, water resources are influenced by other factors than climate alone. The most important of these are vegetation and the nature and condition of the soil profile. On these factors man can and does exert a very significant influence. Consequently, water resources instead of being beyond man's scope of influence are very definitely within his control. It is the extent and nature of this control that man has on water resources which has given rise to considerable controversy and misunderstanding. The common error of over-generalization has frequently been made in attempting to explain man's role in water conservation, but the greatest difficulty has been caused by failing to understand fundamental principles and the lack of basic experimental data. The Coweeta Experimental Forest was established to supply the basic data that will assist in solving problems of land use in relation to water resources.

Research in water resource conservation on the Coweeta Experimental Forest has both national and local significance. The national significance appears particularly with regard to researches into the underlying principles of relationships between vegetation and streamflow which can be obtained only through basic studies of the hydrology of small drainage areas. Several factors combine to make the Southern Appalachian region the outstanding area in the East for researches designed to solve the important problems of land use in relation to water economy: The soil profiles are deep. This is a high-rainfall belt and the precipitation is relatively uniform throughout the year. Most of the precipitation occurs as rain. Temperatures seldom remain below freezing for more than a few days at a time. The hardwood forest that characterizes the region has a widespread occurrence throughout the Eastern United States.

Such studies as these require drainage areas that are independent hydrologic units having distinctive land use patterns. Drainage areas satisfying these requirements and suitable for a long-time research program are not easy to find and this experimental forest was selected only after careful examination of many areas in the Appalachian region. The Coweeta Experimental Forest of 4,600 acres contains 40 small drainages with continuous flow. The average annual rainfall of 70 inches is distributed throughout the year. Mean annual temperature is 55 degrees F. Although the soils are deep and permeable, water tables are sufficiently high to be observed in shallow wells. The natural growth is composed of deciduous trees with abundant shrubs and minor vegetation. Topography and stream pattern favor the establishment of independent experimental units.

Evaluating the effects of land use on water cycle factors, although difficult for large areas, becomes more feasible on these small experimental drainages. Hydrologic measurements are first made over a period of five years or more under conditions of natural forest vegetation before making changes in land use. Records are compared before and after the change. A large number of drainage areas are held unchanged as controls for further comparative checks.

In addition to the national aspects of Forest Influences research in the Southern Appalachian Mountains, there exist many acute forest and water problems of local importance that demand immediate solution. On the Coweeta Experimental Forest studies are being made of woodland grazing, the use of steep mountain land for agriculture, the effect of fires, and the general effects of logging methods.

The maps and other material attached will give a quick picture of the scope of the work on this experimental area and samples of individual study records.

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LOCATION OF COWEETA EXPERIMENTAL FOREST

RI-AP
RESEARCH PROGRAMS
OUTLINE OF RESEARCH PERIM

T INFI

A

COMPARISON OF LAND
EFFECTS ON
STREAM BEHAVIOR

1

Effect of
grazing forest la

2

Effect of forest f

3

Effect of cleari
steep forest lan
for agriculture

4

Comparison of diffe
forest types and con
classes on water yi

5

Timber cutting meth

6

Improvement of
depleted pastured l

C

BASIC STUDIES OF SOIL
HYDROLOGY AS RELATED
TO LAND AND WATER
CONSERVATION

1

Development of technics
for soil hydrology
studies.

2

Field mapping of soil
profile suitable to
watershed studies.

3

Classification and
taxonomy of forest
soils.

4

Geomorphic aspects of
erosion.

APPALACHIAN FOREST EXPERIMENT STATION

DIVISION OF FOREST INFLUENCES

I — EFFECT OF FORESTS ON STREAMFLOW A RESEARCH IN PRACTICAL WATERSHED MANAGEMENT

A — COMPARISON OF LAND USE EFFECTS ON STREAM BEHAVIOR	B — RUNOFF STUDIES BASIC TO INTERPRETING LAND USE HYDROLOGY	C — BASIC STUDIES OF UNDERGROUND WATER STORAGE IN RELATION TO LAND USE
1 Effect of grazing forest land.	1 Channel precipitation. Channel storage.	1 Storage opportunity. Soil profile characteristics as influenced by land use.
2 Effect of forest fires.	2 Drainage area detention of storm water. Subsurface stormflow.	2 Seasonal moisture changes within the zone of aeration.
3 Effect of clearing steep forest land for agriculture.	3 Separation of base flow from the storm hydrograph.	3 Infiltration, retention and detention of storm water.
4 Comparison of different forest types and condition classes on water yield.	4 Correlation of temperature with streamflow.	4 Porosity, permeability, seepage, and percolation.
5 Timber cutting methods.	5 Standardization of experimental drainage areas.	5 Water table studies, index wells, flood and drought prediction.
6 Improvement of depleted pastured land.		6 Normal streamflow depletion as an index to storage and future yield.

II — WATER UTILIZATION BY TREES RESEARCH IN CHANGING VEGETATIVE COVER ON WATER LOSS FACTORS

A — TRANSPIRATION	B — INTERCEPTION OF PRECIPITATION BY TREE CANOPIES
1 Direct studies by permanent removal of major vegetation.	1 Comparison of canopy interception by different forest types and condition classes.
2 Direct studies by temporary removal of major vegetation.	2
3 Direct studies by removal of streambank vegetation.	3
4 Direct studies of diurnal fluctuation of stream wells.	4
5 Indirect studies. Estimates of water requirements for plant growth.	5
6 Indirect studies. Normal streamflow depletion.	6

III — EFFECT OF FOREST ON LOCAL CLIMATE - A RESEARCH IN PRACTICAL PROBLEMS OF IMPROVING LOCAL CLIMATES

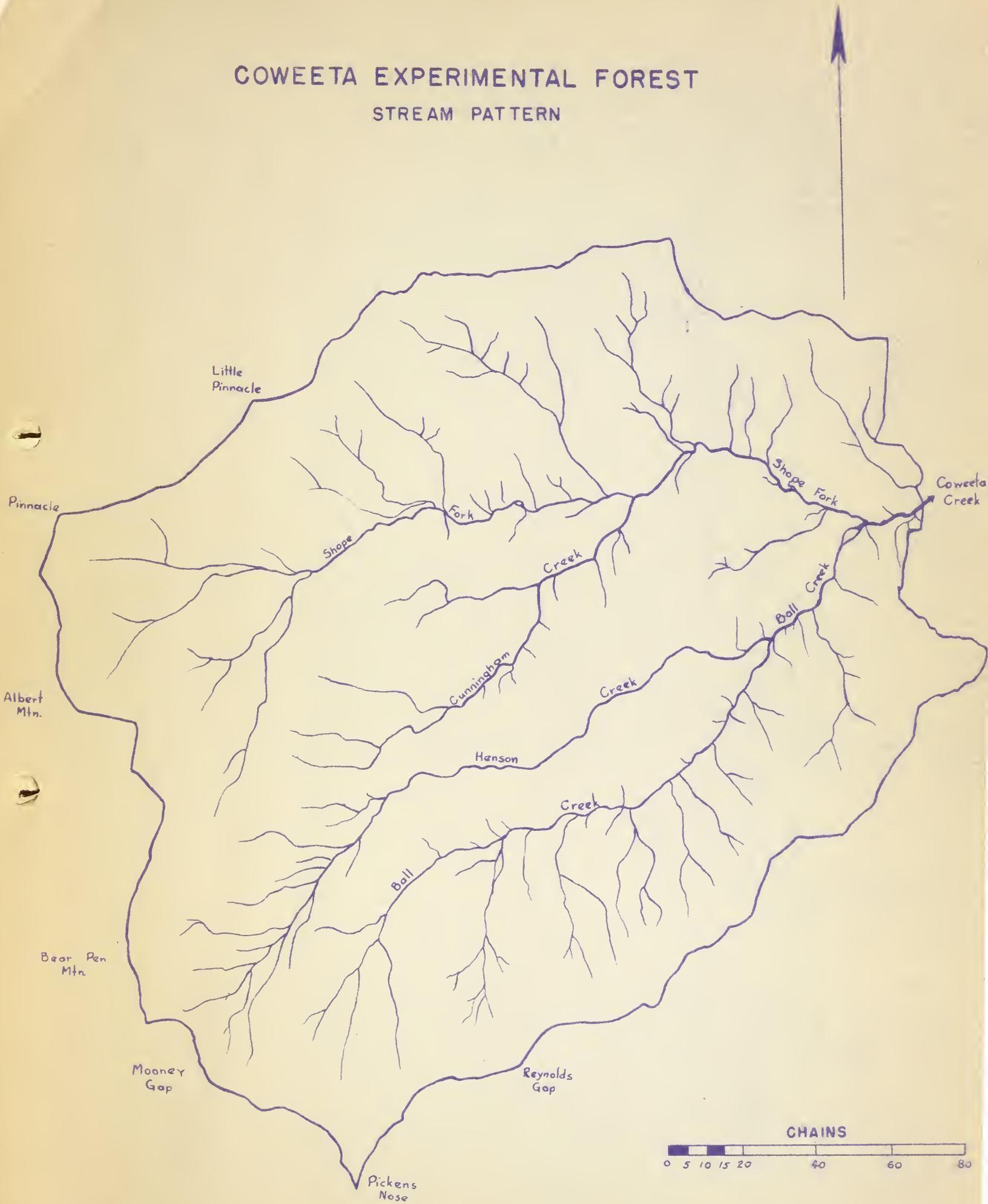
A — EFFECT OF LAND USE ON LOCAL METEOROLOGICAL PHENOMENA	B — PRECIPITATION STUDIES
1 Study of major changes in natural vegetation on meteorological phenomena.	1 Effect of topography and aspect.
2 Effect of denudation by smelter fumes.	2 Storm patterns on experimental drainage areas.
3 Effect of forest on air drainage problems pertinent to agriculture.	3 Effect of trees on accumulation and melting of snow.
4 Use of shade trees in the control of unfavorable climates.	4
5 Insulation effects of forest litter on soil temperatures.	5
6 Soil evaporation as influenced by forest litter.	6

IV — SOIL STABILIZATION A RESEARCH IN REHABILITATION OF DEPLETED SOILS AND EROSION PREVENTION

A — SOIL REHABILITATION OF DEPLETED AND ABANDONED LAND ASSOCIATED WITH AGRICULTURE	B — SOIL STABILIZATION ASSOCIATED WITH ENGINEERING PROJECTS	C — BASIC STUDIES OF SOIL HYDROLOGY AS RELATED TO LAND AND WATER CONSERVATION
1 Effect of tree growth on soil structure, humus type studies.	1 Roadbank naturalization.	1 Development of technics for soil hydrology studies.
2 Technics of land salvage-eite preparation on eterile land.	2 Stream bank and shoreline erosion control.	2 Field mapping of soil profile suitable to watershed studies.
3 Gully control technics.	3 Railroad cuts and fills, embankments and levees.	3 Classification and texonomy of forest soils.
4 Tree planting technics on eroding sites.	4 Sand dune control.	4 Geomorphic aspects of erosion.

COWEETA EXPERIMENTAL FOREST

STREAM PATTERN



COWEETA EXPERIMENTAL FOREST

Drainage Areas

(MAP)

RI-AP
RESEARCH PROGRAMS
General

EXPERIMENTAL DRAINAGE AREAS
OUTLINE OF MANAGEMENT PLANS
FOREST INFLUENCES INVESTIGATIONS

A. SPECIFIC STUDIES PERTINENT TO THE EFFECT OF LAND USE ON WATER AND SOIL RESOURCES. TO OBTAIN BASIC DATA FOR REGIONAL LAND USE PLANNING - SOUTHERN APPALACHIAN MOUNTAINS AND ADJACENT PIEDMONT.

Location	No.	Reason for Establishment	Program	Records	Publications of Results
Coweeta, 23 acres	3	Effect of steep mountain agriculture - Reproduction of local practices - Typical mountain farming	Stream control installed 1934 Clearing . . . . . 1940 Corn . . . . . 1941 Corn and pasture . . . . 1942-3 Pasture only . . . . . 1944-5 Silt Studies 1942-4	Records include: Ground water discharge Storm runoff Total rainfall and Intensity Daily C.S.M. 6 Mos. Summaries Individual storms Complete to date. Blueprints available for specific periods on request.	Reports during period of standardization: Brater, E.F. Proc.Amer.Soc. of Civil Eng. 65:1191-1215, 1939. Hertzler,R.A. Civil Engineering 9:487-489,1939. Hursh,C.R. and Hoover, M.D. Soil Sci.Soc. Amer.Proc. 1942.
Coweeta, 145 acres	7	Effect of unregulated woodland grazing- local practices of allowing stock to range without supplemental feed during summer months.	Stream control installed 1934 Fenced . . . . . 1940 Vegetation analysis. . . 1940 Grazed . . . . . 1941-4 Vegetation analysis. . . 1942-4		
Coweeta, 39 acres	1	Effect of forest fires- Repeated heavy spring burning following litter accumulation.	Stream control installed 1934 Burned . . . . . April 1942 Reburn . . . . . April 1943 Water Quality Studies. . 1942-4		
Coweeta, 212 acres	10	Effect of logging merchantable timber- local practices using horses & skid trails to truck yard.	Stream control installed 1936 Logging. . . . . 1942 Silt Studies 1942-4		
Bent Creek 11 acres	3	Rehabilitation of depleted agricultural land. Improvement of old field pasture.	Stream control installed 1934 Abandoned for crops . . 1930-2 Pastured . . . . . 1936-40 Lime-phosphate, Rye . . 1940 Lespedeza, Rye . . . . 1941 Grass . . . . . Spring 1942		Progress Report on effects of treatments will be prepared in 1943.
Copper Basin 5 acres	6	Revegetation- Smelter denuded area- Black locust planting.	Stream control installed 1934 Denuded . . . . . 1900 Planted . . . . . 1938 Replanted 1942		

RI-AP, RESEARCH PROGRAMS
General

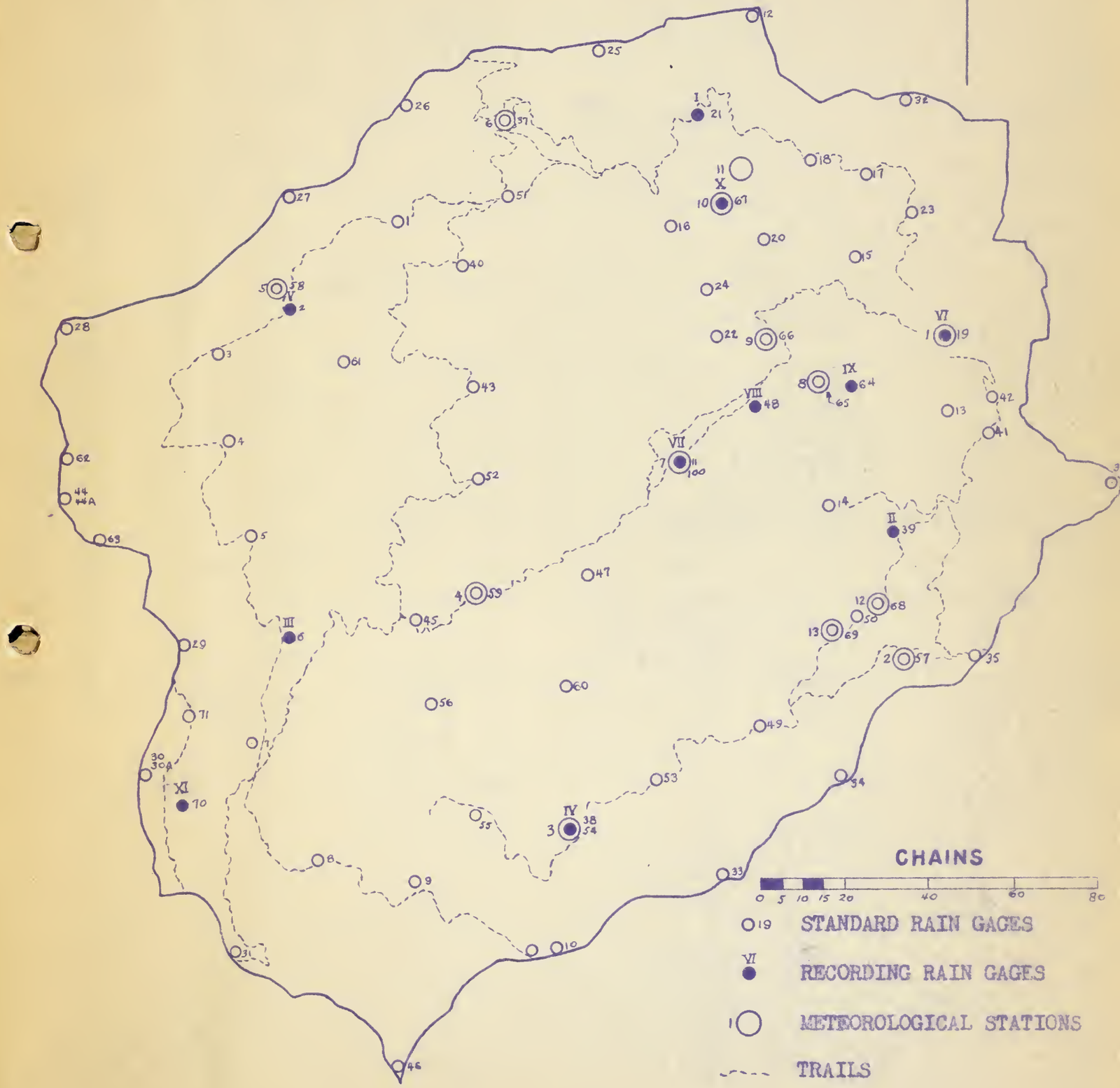
EXPERIMENTAL DRAINAGE AREAS-OUTLINE OF MANAGEMENT PLANS
FOREST INFLUENCES INVESTIGATIONS

B. WATERSHED MANAGEMENT STUDIES PERTINENT TO MUNICIPAL AND INDUSTRIAL WATER SUPPLIES; BASIC STUDIES OF FORESTED DRAINAGES AS EQUALIZING STORAGE RESERVOIRS, STREAM BEHAVIOR, GROUND WATER SUPPLY. WILL ALSO FURNISH FUNDAMENTAL WATER CYCLE DATA FOR RESEARCH IN FORECASTING RUNOFF FOR OPERATION OF POWER RESERVOIRS SYSTEMS.

Location	No.	Reason for Establishment	Program	Records	Publications of Results
Coweeta, 22 acres	6	Effect of removal of riparian vegetation from stream bank.	Stream control installed 1934 Major vegetation less than 15 ft.above streambed cut July 21-25, 1941 No change 1942-5	Records include: Ground water discharge Storm runoff Total rainfall and Intensity Daily C.S.M. 6 Mos. Summaries Individual storms	Reports during period of standardization: Hursh,C.R.and Brater, E.F. Trans.Amer. Geo.Union,1941.
Coweeta, 40 acres	13	Effect of temporary removal of all major vegetation from entire drainage area.	Stream control installed 1936 Cut . . . . . Winter 1939-40 No change 1940-5		
Coweeta, 33 acres	17	Effect of permanent removal of all major vegetation from entire drainage area.	Stream control installed 1936 Cut . . . . . Spring,1941 Sprouts removed.. . July,1942-5		Hursh,C.R., Hoover,M.D.,and Fletcher,P.W. Trans.Amer.Geo. Union,1942.
Coweeta, 6 acres	100	Complete water cycle study, canopy interception, soil moisture, ground water storage, water loss factors	Stream control installed 1936 Interception troughs in place. . . . . 1937 Wells installed . . . . 1938 No change 1936-44	Complete to date. Blueprints available for specific periods on request	Brater, E.F. Proc.Amer.Soc. of Civil Eng. 65:1191-1215, 1939.
Coweeta 3864 a 1877 a 1788 a 943 a 940 a 511 a 501 a 440 a 350 a 152 a 100 or less:	 0 8 9 16 15 20 12 11 28 14 32,22,41 34,19,21 40,18,2	Study of seasonal stream behavior, water storage, channel precipitation, channel storage,flood waves. Reserve and control drainage areas for specific treatments.	Individual drainage areas will be selected for further studies of timber cutting methods, and other manipulation of vegetative cover for stream control. At least 10 selected drainages will be held as permanent controls.		Hertzler,R.A. Civ.Engineering 9:487-489,1939 Progress Reports to be prepared beginning in 1943 for all vegetative cover changes.

COWEETA EXPERIMENTAL FOREST

LOCATION OF RAIN GAGES
AND
METEOROLOGICAL STATIONS



U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

RI_____
Streamflow
_____

PRECIPITATION ON INDIVIDUAL WATERSHEDS

Form 2
File No._____

Experimental Area _____ Watershed _____

Gage Reader_____ Recorded by_____ Date _____ Computed by _____ Date _____

Rain Gage No. (1)	Weight Factor* (2)	Date of Rain 19 Gage Reading (3)	19 Reading × Factor (4)	19 Gage Reading (5)	19 Reading × Factor (6)	19 Gage Reading (7)	19 Reading × Factor (8)	19 Gage Reading (9)	19 Reading × Factor (10)	19 Gage Reading (11)	19 Reading × Factor (12)	19 Gage Reading (13)	19 Reading × Factor (14)	19 Gage Reading (15)	19 Reading × Factor (16)	19 Gage Reading (17)	19 Reading × Factor (18)
Total (Inches)																	

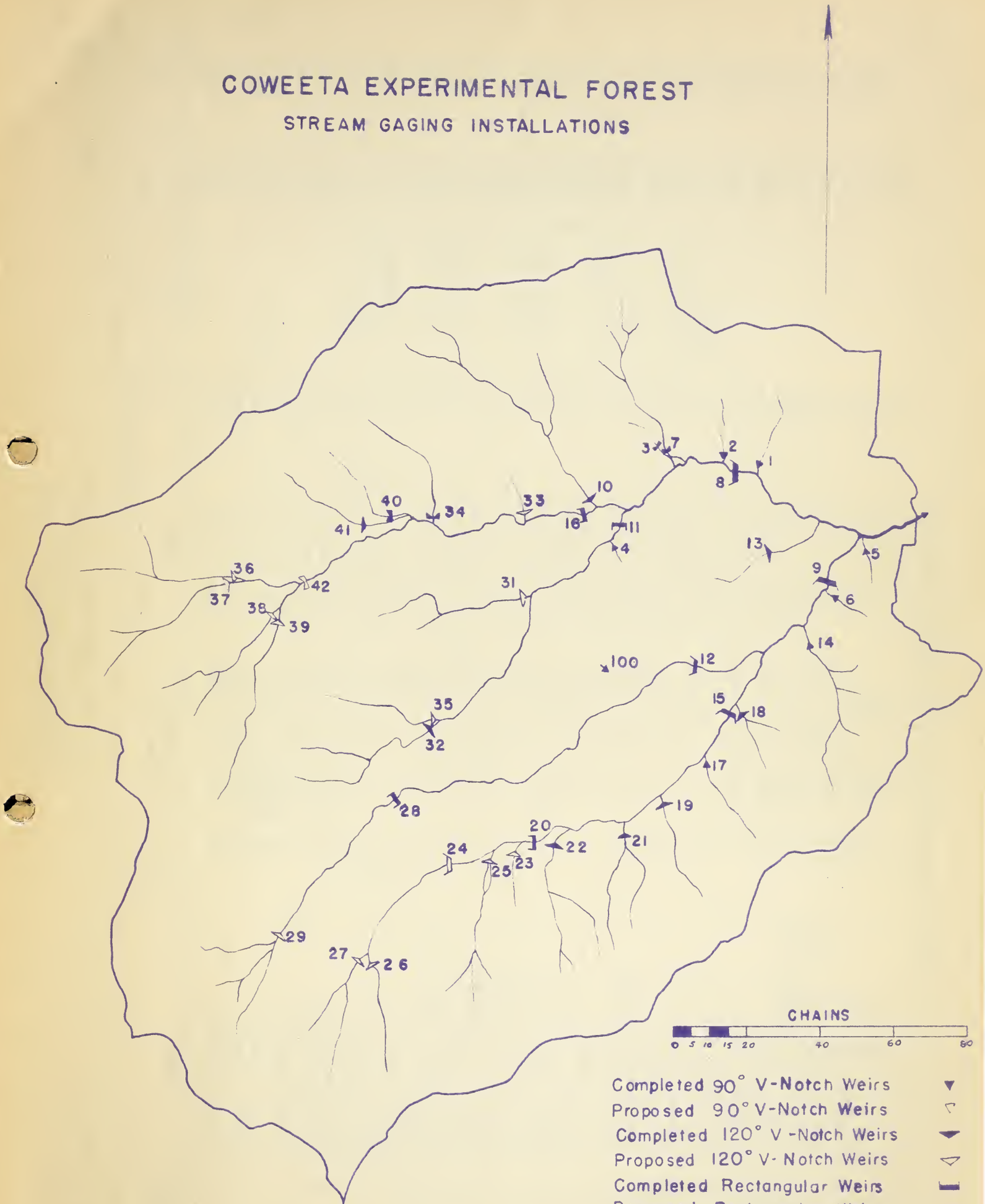
* Where Thiessen Method is used

Period:_____ to _____

Sheet_____ of _____ Sheets

COWEETA EXPERIMENTAL FOREST

STREAM GAGING INSTALLATIONS



RI-AP
STREAMFLOW
Working Plans

COWEETA EXPERIMENTAL FOREST

DRAINAGE AREA INSTALLATIONS

May 19, 1942

Area No.	Name	Area in Acres	Date of First Record	Stream Control: Type	Stream Control: Capacity (a) c.f.s./sq.mi. 2' H	Stream Control: Capacity (a) c.f.s./sq.mi. Maximum	Elev. of Control Ft.	Max. Elev. Ft.
1	Copper Branch	39	June 13, 1934	90° V-notch	228.8		2315	3241
2	Shope Branch	31	June 22, 1934	90° V-notch	288.4		2340	3314
3	Little Hurricane	23	July 5, 1934	C1A Deep notch	720.0	2500.0	2425	3055
4	Jenny Branch	10	July 5, 1934	90° V-notch	894.9		2471	3052
5	Creasman Branch	4	June 30, 1934	90° V-notch	2225.0		2287	2558
6	Sawmill Branch	22	July 10, 1934	90° V-notch	407.8		2282	3260
7	Big Hurricane	145	July 31, 1934	C1A Deep notch	160.0	600.0	2370	3510
8	Shope Fork No. 1	1877	Oct. 6, 1934	12' Cippolletti	39.0	90.0H-3.5	2292	5249
9	Ball Creek No. 1	1788	Oct. 12, 1934	12' Cippolletti	40.9	94.5H-3.5	2253	5097
10	Camprock Creek	212	March 7, 1934	120° V-notch	73.1		2436	3801
11	Cunningham Creek No.1	440	March 5, 1936	5' rectangle	63.0	76.7H-2.3	2407	4056
12	Henson Creek No. 1	501	March 17, 1936	6' Cippolletti	71.6	133.5H-3.0	2412	5097
13	Carpenter Branch	40	March 12, 1936	120° V-notch	387.0		2349	2965
14	Hugh White Branch	152	May 26, 1936	120° V-notch	101.7		2318	3125
15	Ball Creek No. 2	940	Dec. 21, 1936	8' Cippolletti	51.9	95.2H-3.0	2352	4887
16	Shope Fork No. 2	943	June 4, 1936	6' rectangle	35.8	63.4H-3.0	2423	5249
17	Hertzler Branch	33	June 6, 1936	90° V-notch	270.5		2422	3381
18	Grady Branch	31	July 3, 1936	120° V-notch	500.0		2382	3258
20	Ball Creek No. 3	511	July 30, 1937	6' rectangle	66.1	116.8H-3.0	2423	5249
21	Sheep Rock Branch	64	July 22, 1938	120° V-notch	241.9		2370	3853
22	Lick Branch	88	Feb. 18, 1937	120° V-notch	175.3		2780	4089
28	Henson Creek No. 2	350	May 24, 1937	6' rectangle	96.4	170.5H-3.0	3162	5097
34	Bee Branch	76	Oct. 13, 1938	C1A Deep notch	300	1200.0	2775	3900
40	Wolf Rock Branch	58	Dec. 4, 1938	C1A Deep notch	400	1500.0	2860	4000
100	Barker's Cove	7	March 14, 1938	90° V-notch	1271.6		3025	3185
41	Bates Branch	77	Aug. 23, 1940	120° V-notch	201		2930	4260
19	Snake Den Branch	68	May 16, 1941	120° V-notch	228		2440	3670
32	Cunningham Creek No.2	102	Oct. 25, 1941	120° V-notch	152		3020	4050
37	Albert Branch	104	April 15, 1942	120° V-notch	149		3390	5240
36	Pinnacle Branch	108	August, 1942	120° V-notch	143		3350	5050
26	Pickens Branch	69	Sept., 1942	120° V-notch	224		3400	4880
27	Ball Creek No. 5	100	Sept., 1942	120° V-notch	155		3380	4770

(a) All V-notch controls have emergency flood-flow sections.

RI.______
Streamflow

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Form 6
File No.______

RECORD OF RUNOFF

Station Type *______ Experimental Area ______ Station Designation ______

Time Standard (Circle One) E.S.T., C.S.T., M.S.T., P.S.T., Elevation (Datum M.S.L.) ______ Ft. Watershed ______, ______ A

Gage Datum (Elev. of Zero Flow) ______ Ft. Gage Type ______ Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ "

Conversion Factor | C.F.S. = ______ In./Hr. One Inch on Chart = ______ Ft., ______ Time Sec. ______, Tp. ______, Range ______

Date	Time		Time Interval	Gage Height	Discharge Rate				Runoff from Area				Remarks
					For Gage Height	Average for Interval			For Interval		Accumulated		
(1)	Hr	Min. (2)	Min. (3)	Feet (4)	C.F.S. (5)	C.F.S. (6)	In. per Hr. (7)	C.S.M. (8)	Cubic Feet (9)	Inches (10)	Cubic Feet (11)	Inches (12)	(13)

Discharge from Rating Table Dated ______, 19__

* Current Meter, Flume, etc.

Tabulated by ______ Date ______, 19__ Checked by ______ Date ______, 19__

Computed by ______ Date ______, 19__ Checked by ______ Date ______, 19__

Period ______ To ______ Sheet ____ of ____ Sheets